(136)

High-Current Double Pulse ECT Technique for Inspection of Ferromagnetic Materials

Tiago Rocha, **Helena G. Ramos**, Artur L. Ribeiro and Dario Pasadas, Instituto de Telecomunicações, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal

The detection of surface cracks of conductive materials that have a magnetic permeability higher than μ_0, are usually made using the Magnetic Flux Leakage (MFL) technique. It requires the saturation of the specimen so that some magnetic flux lines escape the material when a defect is present. However, saturating the material can be very power consuming and if there is motion involved, eddy currents induced due to motion decrease or even null this method sensitivity as speed increases, which can be a disadvantage in cases such as railroad inspection.

This work proposes a new technique to inspect the surface of ferromagnetic materials based on eddy currents. It is denominated high-current double pulse (Hi-CDP) ECT. The technique creates two consecutive pulses of currents (up to 1500 A) in a coil in the vicinity of the sample. Fig. 1 shows the simulation model used and the corresponding magnetic flux obtained in a point in the axis of a pancake coil (25 turns, id=15 mm, od=25 mm, heigh=10 mm), and in the vicinity of the sample material. The first pulse (starts at 0.1 ms) saturates the material, making it behave almost like a non-ferromagnetic material. The second pulse starts at 0.25 ms when the maximum current of the first pulse occurs (when the material is most saturated). When the second pulse occurs, eddy currents are induced. As the material is saturated, the ferromagnetic properties almost do not interfere with penetration depth and distribution of eddy currents, making it suitable for eddy current testing. Fig. 2 shows the derivative of the magnetic field obtained in a point located between the windings of the coil and the sample material, for a case without defect and in the presence of two similar defects with different depths (0.5 mm and 1.5 mm deep) in the vicinity of the point. It is possible to observe that the second current peak contains a perturbation that is different according to the defect. The signal derivative was chosen in order to distinguish the MFL from eddy currents perturbations.

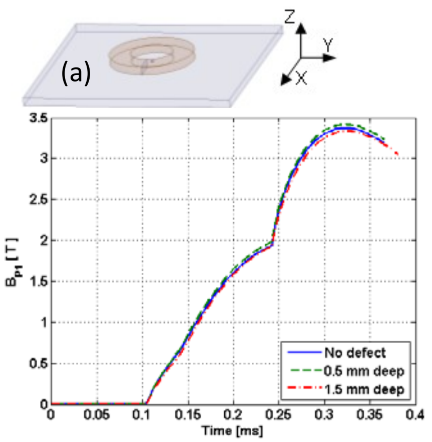

Figure 1. (a) Simulation model. (b) Magnetic field in the core of the excitation coil with Hi-CDP.

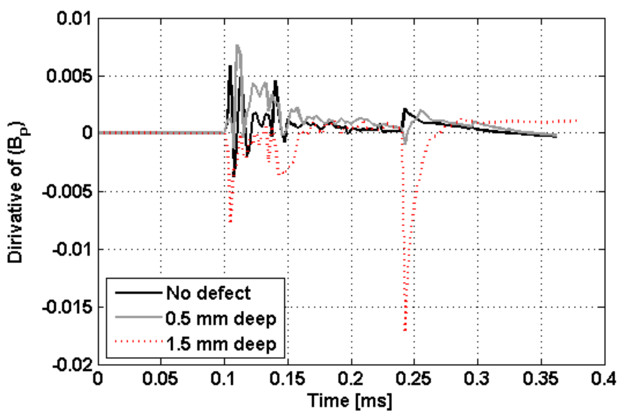

Figure 2. Derivative of the magnetic field without defect and in the presence of two defects with different depths.

References:

1. B. Aldefeld, "Electromagnetic Field Diffusion in Ferromagnetic Materials", Proceedings of the Institution of Electrical Engineers, 125, 278-282 (1978).